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Procedia Computer Science 93 (2016) 367 – 374

Procedia Computer Science

6th International Conference On Advances In Computing & Communications, ICACC 2016, 6-8 September 2016, Cochin, India

Design and Implementation of High Speed Background Subtraction Algorithm for Moving Object Detection

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Abstract

Object detection is important and challenging task in computer vision applications such as surveillance, vehicle navigation, and human tracking. Video surveillance is a key technology to fight against terrorism and public safety management. In video surveillance, detection of moving objects from a video is important for object detection and behaviour understanding. Detection of moving objects in video streams is important process of revelation and background subtraction is popular approach for foreground segmentation. In this paper high speed background subtraction algorithm for moving object detection is proposed. The video is first converted to streams and then applied to convolution filter which removes high frequency noise components to obtain smoothened images. The smoothened images are then applied to background subtraction algorithm with adaptive threshold which gives detected object present in background image. The detected object is then applied to convolution filter to remove the spurious distorted pixels which improves the quality of image. The proposed architecture was designed using VHDL language and implemented using Spartan-6 (XC6SLX45-2csg324) FPGA kit. It is observed that the proposed technique is better compared to existing method in terms of image quality and speed of operations.

Peer-review under responsibility of the Organizing Committee of ICACC 2016

Keywords: Convolution Filter; Moving Window Architecture; Modified Background Subtraction ; Moving Object Detection; Pre-Processing; Adaptive Threshold;

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Peer-review under responsibility of the Organizing Committee of ICACC 2016
doi:10.1016/j.procs.2016.07.222

1. Introduction

In today's modern life the security is must in every field, where video cameras are used for surveillance in all places. Video surveillance devices depend on their ability to detect the interested objects in the video or set of frames which is important step in collecting the details about any image or video. Also it is very helpful in many computers vision applications. Moving object detection[1] in video surveillance systems is the basic step in security applications. The goal of moving object detection is to detect the person or object which is moving in a video with constant background. The moving object detection technique helps in identifying the type of the objects in the path for robotics applications which leads to further decisions on the path planning. In augmented reality, the video information can be seen directly or indirectly on live platform, which can be enlarged and used to track the interested objects. This can also be used to count the number of persons in the crowd or in intruder region. There exist many techniques for moving object detection. Background Subtraction[2] is one of the vital techniques to detect the moving objects. In this method the segmentation of objects is done using subtraction. In video surveillance of borders across the countries, faster transmission and less bandwidth becomes critical factor for data transmission. Background Subtraction helps in segmenting the person of interest by neglecting the background which further reduces the bandwidth data. This information is further transferred at a very faster rate through surveillance system.

2. Literature Surveys

Mahamuni and Patil[3] proposed the moving object detection using background subtraction algorithm. The input images were pre-processed using the median filter and then they were applied to the background subtraction algorithm. The entire system was designed using Simulink block-sets. The VHDL code was generated by using the System Generator token. Mahesh et al.,[4] proposed an algorithm to detect the moving objects acquired by the fixed camera. This algorithm was written in System C and implemented in Micro-Blaze Core processor present in Spartan 6 FPGA kit. Himanshu Goyal[5] proposed the frame differencing algorithm for moving object detection with adaptive threshold in HSV color space which is implemented using Simulink block-sets to detect the moving vehicles, pedestrians in urban traffic video sequences. Reza et al.,[6] proposed simultaneous tracking of multiple non-stationary targets in video in which multi-target function was applied on the background subtracted grey scale image which allowed multi-target posterior to be efficiently propagated forward using multi-Bernoulli filter. Jing Ming et al.,[7] proposed the Multi-layer Codebook based Background Subtraction model (MCBS) for detecting the moving objects in video sequences. Multi-layer block based strategy and adaptive feature extraction from blocks of various sizes were combined to remove the non-stationary background. Xiaowei Zhou et al.,[8] proposed a method for Detecting Contiguous Outliers in Low-rank Representation (DECOLOR) which had integrated object detection and background learning in a single process of optimization for accurate detection of moving objects in video sequences. Paresh et al.,[9] proposed the moving object detection method using mixture of Gaussian (MoG) and Haar Wavelet methods. The MoG method was more accurate but had larger time complexity. This was mainly used for static and complex background applications required a lengthy process for object detection. In this method, the video frames were down sampled using Haar Wavelet decomposition and applied to the MoG model for subtracting the background. The bounding boxes were applied on each moving objects for calculating the location and size of the moving objects. Pranab kumar dhar et al.,[10] proposed an efficient moving object detection method, which used gradient directional masking and enhanced edge localization mechanism. In this method, the gradient operator was used for generating gradient map images from the input image and the background image. The input gradient map and background gradient maps were subtracted from each other. The resulting difference map was called the gradient difference map. The moving object detection was achieved by using an appropriate directional masking and thresholding. Csaba Kertesz[11] introduced the Local Binary Pattern (LBP) texture descriptor for image indexing and texture classification in order to segment the foreground from the complex background. Leibe et al.,[12] proposed a method for multi-object tracking where multi-category object detector was used for localizing the cars and pedestrians in the input images. Thus automatic initialization and tracking large and varying sizes of moving objects from both static and moving cameras was achieved. Zhou J et al.,[13] proposed an algorithm for moving vehicle detection in which background estimation was achieved through adaptive technique and a low-dimensional feature and a classifier were used for segmenting the vehicle parts. Marko Heikkil and Matti Pietik Ainen[14] proposed a